Challenges in Recommender Systems for Tourism

Manoj Reddy Dareddy University of California, Los Angeles California, USA mdareddy@cs.ucla.edu

ABSTRACT

In this position paper, we outline some of the challenges facing recommender systems in the tourism domain. The problems in this domain are unique compared to the traditional recommender systems. The challenges outlined in this paper include: dynamic itinerary planning, mobile platform, evaluation methods, group recommendation, social network, integration, serendipity, user modeling, privacy and robustness. We provide an overview for each of the topics and present the opportunities for improvement. The tourism domain consists of a large amount of information stored digitally and recommender systems can act as a filter that can personalize the experience for every tourist.

Categories and Subject Descriptors

H.4 [Information Systems Applications]: Miscellaneous;

Keywords

Tourism; Recommender Systems; Position paper

1. INTRODUCTION

Tourism broadly refers to the movement of people who are exploring new places. Globally, [1] it accounts for 10% of the world's GDP and it supports about 1 in 11 jobs around the globe. It is one of the fastest growing sectors and many nations depend on it as a major source of income. It can be classified into various categories based on their primary motive such as medical, educational, artistic, sports tourism etc. This domain consists of enormous amount of information stored digitally that is not being used to its maximum potential. Recommender systems have huge opportunity in improving the experience of the tourists. This position paper presents various technical challenges that have not yet been addressed by the recommender system community in the tourism domain. The goal of this position paper is to discuss the open problems in this area for researchers to work on.

2. CHALLENGES

2.1 Dynamic Itinerary Planning

One of the main challenges in this domain is optimal itinerary planning for tourists. Tourists generally have an agenda in mind of different places to visit in a city or events to attend, restaurants to try etc. There exist systems that recommend places to visit based on user interest but they are all static in nature. They do not take into account changes that take place in real-time. For example, if a tourist would like to visit Paris, the system should be able to dynamically figure out the opening times and recommend an itinerary. There have been attempts to model this as an optimization problem where the objective function is to maximize a user specific satisfaction metric subject to constraints such as opening times, budget etc. An example of a user specific metric could be the number of places visited or cost etc.

Copyright held by the author(s).

RecTour 2016 - Workshop on Recommenders in Tourism held in conjunction with the 10th ACM Conference on Recommender Systems (RecSys), September 15, 2016, Boston, MA, USA.

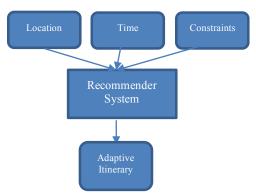


Figure 1: Itinerary generation

An important aspect of such systems is the human interface since it ultimately determines the interaction with the user. In this regard, the design needs to ensure a minimal amount of cognitive effort on the user's part.

2.2 Mobile

The future of computing is mobile. Mobile plays a very important role in this domain since tourists are always on the move. Hence, it is important for recommender systems to take advantage of contextual information such as location, time of day etc. These mobile devices also allow different types of interactions to be captured such as emotion, whether the user is travelling alone or with a group etc. The location information allows the system to recommend events, places to see that are physically close the user.



Figure 2: Mobile devices have a huge role to play in tourism

Another important aspect of mobile that shall play an important role in the future is its ubiquitous nature. This will ensure that the user gets access to the right information at the right time and right location. Current systems such as Google Now, perform such ubiquitous computation by leveraging information from various sources to personalize the user experience.

2.3 Evaluation Methods

The current evaluation methods for recommender systems mostly consider explicit feedback. The most popular techniques being used are Root Mean Squared Error (RMSE) and MAE (Mean Average Error), which relies on explicit user feedback.

$$\sqrt{rac{\sum_{t=1}^n (\hat{y}_t - y_t)^2}{n}}$$

RMSE error calculation

Another commonly used evaluation technique is Mean Average Error (MAE) which is defined as follows:

$$ext{MAE} = rac{1}{n} \sum_{i=1}^n |f_i - y_i| = rac{1}{n} \sum_{i=1}^n |e_i|$$

Mean Average Error calculation

Both these metrics measure the difference between the predicted and actual value on a test dataset. These metrics depend on the explicit user information such as ratings feedback.

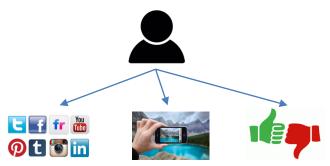


Figure 2: Different forms of feedback by a tourist

Recommender systems in the tourism domain need to be able to gauge user satisfaction level by measuring their emotion in a minimally-intrusive manner. Some of the possible methods includes analyzing the user's social media, pictures being taken and explicit user feedback such as ratings or like/dislike.

2.4 Group Recommendation

Tourists generally travel in groups and current recommendation systems mainly focus on a single user rather than a group. The main challenge is to combine individual preferences of different members and recommend items that are enjoyed by the group as a whole. Certain groups might be more interested in adventure activities whereas others might be inclined towards historical/cultural places. Some of the variables that need to considered are: number of members in the group, individual restrictions and group characteristics.

2.5 Social Network

Social connections play an important role in the recommendation for tourism. For example, if a user's friends recommend trying a restaurant in a different city, then the user is likely to visit that restaurant. There are various types of social influence that ranges from different degrees. One possibility is to integrate existing social network information from sites such as Facebook, Twitter etc. The level of influence depends on the closeness of the user with another user, since it is more natural to trust close friends than users who are 3 or 4 degrees away.

2.6 Integration

The main challenge facing tourists is the integration of various sources of information. For example, the user needs to decide on the airline, hotel, transportation method, tickets to various events etc. It is would be nice to have an end-to-end system that integrates such information in a condense format. The main

challenge is to understand the preference of each user and filter out relevant information such as hotel deals etc.

Advertising can play a very important role in recommender systems. A prime example of this is the Google Adwords program. It aims to provide relevant ads that are useful and the user is most likely to click. Similarly, for recommender systems, ads play a very important role since they allow users to learn about relevant promotions such as hotel rooms, restaurant deals etc. Such an interface will allow a tourist to perform all relevant computation without having to switch between different applications which can be cumbersome. Also, it would be helpful if adequate information is provided for various places-of-interest.



Figure 3: Integrated console of all tourist related activity

2.7 Serendipity

Serendipity refers to the idea of discovering a new interest that the user had no idea about. These types of recommendations are the most effective but also the riskiest. The reward is high but the accuracy also tends to be low. In the tourism domain, if a user is interested in art history, the user might be interested in ancient monuments which is a completely different interest. Such models can be learnt using machine learning techniques that process large amounts of behavioral data.

2.8 User Modeling

There also needs to be better user modeling that is able to understand latent user interests. In the tourism domain, the user interests can be organized based on a taxonomy for example: nature, food, etc. This requires building new algorithms that can scale better with different types of input data. Existing techniques such as collaborative filtering, matrix factorization etc. could be applied in this area. Moreover, collaboration with tourism domain experts shall help in better modeling of the user.

2.9 Privacy

Privacy plays a very important role in recommender systems. Since these systems have a lot of personal information, it becomes imperative to protect the privacy of the users. Current systems focus on differential privacy and use aggregates that prevent from identifying individual records.

2.10 Robustness

The systems are vulnerable to manipulation and it becomes important to protect them from various types of attacks. For example, a malicious user might target a competitor by creating

fake accounts and down-rating their system, meanwhile increasing the rating of own system.

3. CONCLUSION

The tourism sector presents a number of opportunities for recommender systems. There are many challenges some of which have been outlined in this position paper. These tourism domain specific problems require innovative approaches for implementing recommender systems that can be used by a large number of tourists.

4. ACKNOWLEDGMENTS

Our thanks to ACM SIGCHI for allowing us to modify templates they had developed.

5. REFERENCES

[1] World Tourism Organization UNWTO. (n.d.). Retrieved June 23, 2016, from http://www2.unwto.org/content/whytourism